



Ipsilateral Rotational Autokeratoplasty

İpsilateral Rotasyonel Otokeratoplast

Ipsilateral Rotational Autokeratoplasty

Yeşim Altay
Department of Ophthalmology, Ufuk University Faculty of Medicine, Ankara, Turkey

Özet

Kornea skarı tüm dünyada monooküler körlüğün önde gelen nedenlerinden biridir, kornea transplantasyonu ise dünyada en çok yapılan solid organ transplantasyonudur. Kornea skarlarının tedavisi için uygulanan keratoplasti teknikleri lameller allokeratoplasti ve penetran allokeratoplastiyi kapsar. İpsilateral rotasyonel otokeratoplasti ise kornea skarı olan bazı hastalar için standart penetran keratoplastiye etkin bir alternatif olabilir. Bu işlem hastanın kendi korneasının, skarlaşmayı uzaklaştırarak şeffaf korneayı görme eksenine getirecek şekilde, döndürülmesini içerir. Rotasyonel keratoplasti için hasta seçiminde dikkate alınması gereken önemli bir konu, korneal skar boyutudur. İpsilateral otokeratoplasti sonrası daha fazla astigmatizma ve daha az korneal pupiller şeffaf bölge bulunmasına bağlı olarak penetran allokeratoplasti kadar iyi görme kalitesi sağlayamayabilir. Ancak pediatrik hastalar veya vaskularize kornealı hastalar gibi allogreft rejeksiyon riski yüksek olan hastalarda etkin bir alternatif cerrahi teknik olabilir. Ayrıca bu tekniğin kullanılması, gelişmekte olan ülkelerdeki donör kornea dokusu kısıtlılığına en azından kısmi çözüm sağlayabilir.

Anahtar Kelimeler

Kornea; Kornea Nakli; Kornea Opasitesi

Abstract

Corneal opacity is a leading cause of monocular blindness, and corneal transplantation is the most commonly performed solid organ transplantation in the world. Keratoplasty techniques for corneal opacities include lamellar allokeratoplasty and penetrating allokeratoplasty. Ipsilateral rotational autokeratoplasty can be an effective alternative to penetrating allokeratoplasty for some patients with corneal scars. This procedure involves a rotation of the patient's own cornea to move opacity out of the visual axis. An important consideration when selecting cases for rotational autokeratoplasty is the dimensions of the corneal scar. Although ipsilateral autokeratoplasty may not provide as good a quality of vision as penetrating allokeratoplasty because of higher astigmatism and reduced corneal pupillary clear zone, these disadvantages are often outweighed when the risk of allograft rejection is high, as in pediatric patients and those with vascularised corneas. This technique would at least partially resolve the issue of scarcity of donor corneal tissue in developing countries.

Keywords

Cornea; Corneal Transplantation; Corneal Opacity

DOI: 10.4328/JCAM.4599

Received: 01.05.2016 Accepted: 23.06.2016 Printed: 01.09.2016

J Clin Anal Med 2016;7(5): 753-6

Corresponding Author: Yeşim Altay, 48. Cadde No: 33/31 Cukurambar, 06520, Ankara, Turkey.

GSM: +905324902298 E-Mail: altayye@yahoo.com

Introduction

Corneal opacity is a leading cause of monocular blindness worldwide. The definitive treatment of visually-impairing corneal opacity is penetrating allogenic keratoplasty using donor corneal tissue. Although corneal scar and keratitis are the most frequent indications for keratoplasty in developing countries, corneal edema and keratoconus constitute the majority of patients undergoing penetrating keratoplasty in developed countries. The reported success rate for penetrating corneal grafts is 73% at 5 years, and 62% at 10 years [1]. However, endothelial rejection rates are 15-20% in adults and 10-50% in pediatric grafts [2,3]. Rejection rates are higher in pediatric corneal transplantation because of the more active immune systems of younger patients [4]. In addition to rejection, late corneal failure is anticipated due to the continuing loss of donor corneal endothelial cells with time [5]. More importantly, the accessibility to corneal tissue for corneal grafting is a major limiting factor. Because of the increasing gap between demand and supply of donor corneal tissue, alternative techniques have been devised. One of them is rotational autokeratoplasty, which is indicated for patients with a limited corneal opacity involving the visual axis. This procedure involves a rotation of the patient's own cornea to move opacity out of the visual axis and to replace it with clear cornea [4,6-9].

Several authors have suggested the use of different graft shapes for ipsilateral autokeratoplasty, such as a triangle or a figure eight [9,10]. However, none has replaced the standard circular graft with an eccentric center [11-15].

Like any other surgical technique, appropriate patient selection is required for successful rotational autokeratoplasty. Usually rotational autokeratoplasty is chosen for nonprogressive corneal scars following blunt and penetrating corneal trauma, postinfectious keratitis scar, chemical injuries, and idiopathic or postherpetic lipid keratopathy [6,8,9,16,17]. These patients are at high risk of allograft corneal rejection if subjected to a conventional keratoplasty. Other than the usual indications, Cunha et al. described ipsilateral penetrating autokeratoplasty associated with a crescent-shape resection of 0.5 mm of the inferior cornea as an alternative method to corneal transplantation for keratoconus. They reported reduction of visual acuity with increased astigmatism during the follow-up period [18].

An important consideration during selection of cases for rotational autokeratoplasty is the dimensions of the corneal scar. A four to five mm of clear peripheral cornea is required to obtain at least 3 mm of central clear cornea, free of suture track scars.

Surgical Technique

The surgical technique performed is identical to that of conventional penetrating keratoplasty, with the exception that the host cornea is eccentrically cut and then rotated before suturing. Because of the more rapid loosening of sutures that occurs when they are placed into the anterior sclera, interrupted sutures are recommended for rotational autokeratoplasty.

Several authors have described methods for determining the size and location of the trephination. McDonnell et al. [9] recommended the following guidelines:

"1. Use the maximum area of available clear cornea (this usually meant making the peripheral edge of the graft very near the limbus).

2. Try to ensure that the opacity to be rotated is as near the edge of the graft as possible; this allows maximum movement of the opacity by the rotation and its replacement with the

maximum area of the clear cornea.

3. Make the central edge of the graft at least 3 mm away from the visual axis. This ensures clear cornea at the visual axis and minimizes the affect [sic] of the suture.

4. If possible, rotate the opacity under the upper lid."

In guidelines formalised by Roa and Lam [14], the center of the cornea is marked and a point 2.5 mm away from the center is marked in the opacity. A third mark is made 2.0 mm away from the central mark in line with the second mark, and a fourth mark is made 3.5 mm away from the third. The distance between marks 2 and 4 is taken as the trephine size to be used [14] (Figure 1).

The mathematical formulas for determining the size of the donor and host trephination have been described by several authors. The two most useful are described by Bourne and Brubaker [19] and Jonas et al. [7]. In Bourne and Brubaker's method [19], two measurements were taken. First, the diameter of the

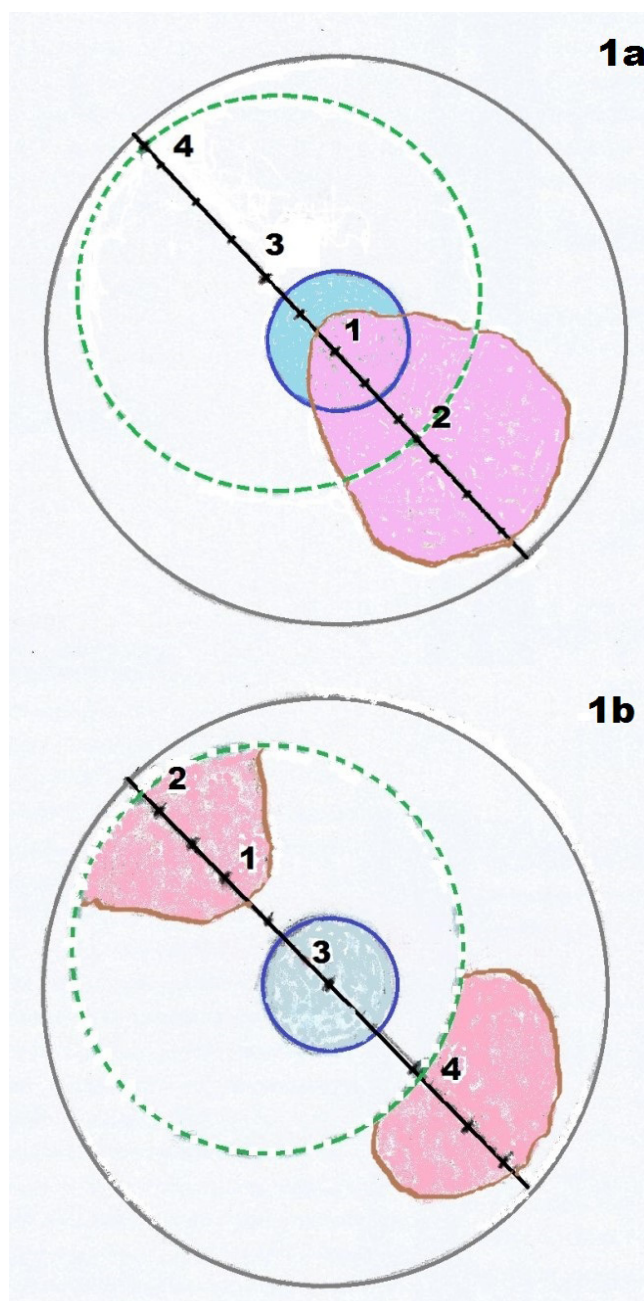


Figure 1. Schematic picture of cornea with opacity involving pupillary area. The center of the cornea is marked (1), and a point 2.5 mm away from center is marked in the opacity (2), third mark is made 2.0 mm away from the central mark, in line with the second mark; a fourth mark is made 3.5 mm away from the third (a). Depiction of rotation of calculated corneal graft (b).

largest circle of the clear cornea was measured. Second, the shortest distance from the edge of this circle to the geometric center of the cornea was assessed (this was considered positive if the opacity involved the center of the cornea and negative if the opacity was within the largest area of the clear cornea). The required trephine size was obtained with the following equation: 1.5 multiplied by the diameter of the largest clear circle added to the shortest distance from the circle to the corneal center [19]. The other formula, by Jonas et al. [7], utilises a trephine size of 0.75 of the overall corneal diameter, when the scar lies at the geometric center of the cornea, and adjusts this according to extent of the scar. Both the Jonas et al. [7] and Bourne and Brubaker formulas [19] give similar results, with the Jonas et al. [7] formula resulting in a slightly larger trephine size.

Another approach to postoperative simulation of rotational autokeratoplasty uses digital imaging. Agarwal et al. [15] have described the use of digital image manipulation software (Adobe Photoshop, version 5.0) to plan the size, location, and rotation of the graft. Using the drawing tool, a circle approximating the pupil was drawn on a new transparent layer created on the original image of the eye. Subsequently, a circle was drawn on the original photograph of the cornea to simulate corneal trephination. The corneal area within this circle was rotated on the image to simulate rotational autokeratoplasty. This step was repeated using varying sizes and positions of the larger circle, which simulated the corneal trephine, to include the maximum area of the clear cornea within the pupillary axis [15].

Outcomes

Several case series have been reported, as presented in Table 1. In previously published studies of autokeratoplasty, graft survival was noted to be $\geq 90\%$. In a study by Murty et al. [6], only 3 of 22 grafts failed, two because of prolonged operative time and one because of uncontrolled glaucoma. Ramappa et al. [4] reported that the success rate was 81.25% over a mean follow-up of 29.43 months in pediatric patients. Bertelmann et al. [18] reported only one failure out of seven cases, which they attributed to a triple procedure and preoperative poor endothelial cell count (1200 cells/mm²). Continued endothelial loss is the major cause of graft failure following allograft corneal transplanta-

tion. Although long-term results are unknown, Bertelmann et al. [20] showed that mean endothelial cell loss at 1 year was 15% in rotational autografts compared with 40% in homografts.

The published case series in the literature have reported significant number of patients achieving good visual outcomes. In a report by McDonnell and Falcon [9], 2 patients did not have any astigmatic correction and four other patients had correction ranging from 1.25 to 4 D cyl. Murty et al. [6] reported 1 to 2.5 D cyl in 58.8% of patients, 3 to 5.5 D cyl in 23.5%, and 6 to 9 D cyl in 29.4%. Only Jonas et al. [7] compared visual outcomes after rotational autokeratoplasty with those of a nonrandomized control group of penetrating allografts, and found significantly lower postoperative visual acuity and higher corneal astigmatism in patients having rotational autokeratoplasty. The eccentric trephination, disparity of corneal thickness between the peripheral clear cornea and the central scarred cornea into which it is sutured, and the proximity of one edge of the trephination to the center of the cornea are potential reasons for increased astigmatism after rotational autokeratoplasty [7].

The most common postoperative complication reported after rotational autokeratoplasty was wound leak [6]. This was probably because of the difficulties in tissue apposition while suturing due to differences in the thickness of the central and peripheral cornea as well as scarred versus normal tissue. Also, the cosmetic outcome of autokeratoplasty is inferior to that of conventional penetrating keratoplasty. The corneal opacity is visible postoperatively, although it seems smaller because it is bisected during trephination.

Although rotational autokeratoplasty does not provide as high a level of best-corrected visual acuity as penetrating keratoplasty due to higher astigmatism, there are several advantages that outweigh these disadvantages in many patients whose risk of allograft rejection is higher than normal, such as pediatric patients and those with vascularised cornea:

1. This technique does not require a donor cornea and there is no risk of transmission of infection such as human immunodeficiency virus or hepatitis.
2. Most importantly, this technique obviates the lifelong risk of allograft rejection. This can be a very important factor in some patients, such as those with traumatised eyes with extensive corneal vascularisation, in children or young adults, and in those

Table 1. Summary of studies giving outcomes for ipsilateral rotational autokeratoplasty

Authors	Number (n)	Cause of Corneal Opacity	Mean Follow-up (months)	Trephination Size (mm)	Visual Outcomes and Mean Astigmatism	Complication
McDonnell et al.[9]	16	Trauma (14) Trachoma (2)	27	Mean 8 (7-10) mm	13 significantly improved, 8 were 6/12 or better. Astigmatism range (1.25-4.0 D)	Two developed a loose suture
Verma et al.[8]	17	Leucoma (76.4%) macular corneal opacities (23.5%)	Uncertain	Mean 7 (6-7.5) mm	All improved from preop HMs to 5/60 – 6/9. Eight were 6/12 or better. Astigmatism not reported	One traumatic wound dehiscence. One residual opacity in pupillary zone
Murty et al.[6]	27	Trauma (12) keratitis (8) chemical burns (4) congenital pathology (2) unknown (1)	12	Range 6.5-9.0 mm	13 were 20/80 or better. Seven were 20/40 or better. Mean astigmatism 4.25 D	Wound leak (7) graft failure (3) ant. Polar cataract (1) glaucoma (1)
Jonas et al.[7]	9	Traumatic corneal scars	31.27	7-9 mm	All improved to mean 0.28. Mean astigmatism 6 D	None
Bertelman et al.[18]	7	Trauma (4) postkeratitis (3)	39	7-8.5 mm	Mean improvement 3.5 lines	One graft decompression
Agarwal et al.[15]	5	Keratitis (4) traumatic scar (1)	6	8.25 – 8.75 mm	$\geq 6/18$ in all cases	No
Ramappa et al.[4]	33 (pediatric age patients)	Traumatic (20) microbial keratitis (8) chemical injury (3) undetermined (2)	27 \pm 37	6.5 – 8 mm	All improved preop 2.05 \pm 0.96 to 1.25 \pm 0.84. Mean astigmatism 4.04 \pm 2.21 D	Wound leak (4)

where follow-up is difficult.

3. Another advantage is reduced healing time, which allows early suture removal and reduction in the dose and duration of corticosteroid use postoperatively, thus avoiding steroid-induced complications such as cataract and glaucoma.

Conclusions

Ipsilateral rotational autokeratoplasty can be a viable alternative to conventional penetrating keratoplasty in some patients whose risk of allograft rejection is higher than normal. It avoids the risk of allograft rejection or long-term use of corticosteroids and obviates the waiting period for high-quality donor cornea tissues. Careful selection of patients can yield encouraging results with the use of this alternative technique.

Competing interests

The authors declare that they have no competing interests.

References

1. Williams KA, Lowe MT, Bartlett CM, Kelly L, Coster DJ. The Australian Corneal Graft Registry 2007 Report. Adelaide: Flinders University Press; 2007.p.114-8.
2. Claesson M, Armitage WJ, Fagerholm P, Stanovi U. Visual outcome in corneal grafts: a preliminary analysis of the Swedish Corneal Transplant Register. *Br J Ophthalmol* 2002;86(2):174-80.
3. Wagoner MD, Al-Ghamdi AH, Al-Rajhi AA. Bacterial keratitis after primary pediatric penetrating keratoplasty. *Am J Ophthalmol* 2007;143(6):1045-7.
4. Ramappa M, Pehere NK, Murty SI, Chaurasia S, Rao HL, Sangwan VS. Rotational autokeratoplasty in pediatric patients for nonprogressive paracentral corneal scars. *Ophthalmol* 2012;119(12):2458-62.
5. Armitage WJ, Dick AD, Bourne WM. Predicting endothelial cell loss and long-term corneal graft survival. *Invest Ophthalmol Vis Sci* 2003;44(8):3326-31.
6. Murty S, Bansal AK, Sridhar MS, Rao GN. Ipsilateral rotational autokeratoplasty. An alternative to penetrating keratoplasty in nonprogressive central corneal scars. *Cornea* 2001;20(5):455-7.
7. Jonas JB, Rank RM, Budde WM. Autologous ipsilateral rotating penetrating keratoplasty. *Am J Ophthalmol* 2001;131(4):427-30.
8. Verma N, Melengas S, Garap JA. Ipsilateral rotational autokeratoplasty for the management of corneal opacities. *Aust N Z J Ophthalmol* 1999;27(1):21-5.
9. McDonnell PJ, Falcon MG. Rotational autokeratoplasty. *Eye* 1989;3(5):576-80.
10. Wilson RS. 'Figure 8' ipsilateral autokeratoplasty: A modification using standard corneal trephines. *Arch Ophthalmol* 1976;94(1):121-2.
11. Arnalich-Montiel F, Dart JK. Ipsilateral rotational autokeratoplasty: a review. *Eye* 2009;23(10):1931-8.
12. Jhanji V, Sharma N, Agarwal T, Vajpayee RB. Alternatives to allograft corneal transplantation. *Curr Opin Ophthalmol* 2010;21(4):301-9.
13. Afshari NA, Duncan SM, Tanhehco TY, Azar DT. Optimal size and location for corneal rotational autografts. A simplified mathematical model. *Arch Ophthalmol* 2006;124(3):410-3.
14. Rao SK, Lam D SC. Calculating graft size and position in rotational corneal autografting: A simplified approach. *Indian J Ophthalmol* 2008;56(3):233-5.
15. Agarwal T, Sharma N, Jhanji V, Vajpayee RB. Computer simulation-assisted rotational autokeratoplasty with pupillary enlargement for management of cases with partial corneal opacification. *Br J Ophthalmol* 2010;94(1):24-5.
16. Sah WJ, Myoung YW, Hahn TW, Kim JH. Rotational autokeratoplasty in advanced lipid keratopathy. *Ophthalmic Surg Lasers* 1997;28(12):1020-4.
17. Gunes A, Kansu Bozkurt T, Unlu C, Sezgin Akcay BI, Bayramlar H. Ipsilateral rotational autokeratoplasty for the management of traumatic corneal scar. *Case Rep Ophthalmol Med* 2012; 2012: 853584. doi: 10.1155/853584.
18. Cunha FJ, Lira W, Brandt CT. Refractive and topographic changes of ipsilateral rotational autokeratoplasty with a crescent-shape 0.5 mm resection of the inferior cornea in keratoconus after a 24 months follow-up. *Arq Bras Oftalmol* 2011;74(3):184-9.
19. Bourne WM, Brubaker RF. A method for ipsilateral rotational autokeratoplasty. *Ophthalmology* 1978;85(12):1312-6.
20. Bertelmann E, Hartmann C, Scherer M, Rieck P. Outcome of rotational keratoplasty: comparison of endothelial cell loss in autografts vs allografts. *Arch Ophthalmol* 2004;122(10):1437-40.

How to cite this article:

Altay Y. Ipsilateral Rotational Autokeratoplasty. *J Clin Anal Med* 2016;7(5): 753-6.